

## News

## Long-Range Space Objectives

At the request of the National Aeronautics and Space Administration (NASA) the National Research Council's Space Science Board has undertaken a special study of the long-term (post-1985) objectives of U.S. research in the space sciences. The study will involve two to three summer sessions as well as disciplinary group meetings during the intervals between the summer sessions. This special study is intended to build upon and considerably extend the strategy reports in the various space science disciplines that the board has been involved in formulating over the past few years.

In the first meeting of the entire study, held at Woods Hole, Mass., August 20-29, each of the disciplinary panels formulated a draft report on the present status of their sciences and the expected space science missions to the year 1995. These expected missions are based upon the science strategies as contained in the reports of the several committees of the Space Science Board. The individual task groups also developed, in a very preliminary fashion, scientific objectives and space science missions that might well be considered for implementation in the post-1985 era.

The study is organized around a steering group and is being conducted by this steering group plus six disciplinary panels, consisting of approximately 12 individuals each. Present membership of the steering group includes T. M. Donahue (Chairman), University of Michigan; D. Anderson, California Institute of Technology; R. Berliner, Yale; B. Burke, Massachusetts Institute of Technology; A. G. W. Cameron, Harvard; H. Friedman, NASA; D. Hunt, University of Arizona; F. Johnson, University of Texas, Dallas; S. M. Krimigis, Applied Physics Laboratory/Johns Hopkins University; E. Levy, University of Arizona; F. B. McDonald, NASA; L. Margulis, Boston University; J. Naugle, Fairchild Industries; F. Scarf, TRW; E. Stone, California Institute of Technology; S. Swisher, Michigan State University; J. A. Van Allen, University of Iowa; and R. Weiss, Massachusetts Institute of Technology. The chairs of the disciplinary panels are R. Weiss (Fundamental Physics and Chemistry), D. Hunt (Planetary/Lunar Exploration), B. Burke (Astrophysics/Astronomy), D. Anderson (Earth Sciences), F. Scarf (Solar/Space Plasmas), and L. Margulis (Life Sciences).

Objectives of the task groups during the next year will be the continued definition and refinement of the long-term space science objectives and possible mission models on the basis of the expected positions of the various disciplines in 1995 as discussed in the past board strategies. In the next year there will also be concerted efforts to discuss widely within the individual constituent scientific communities the activities of the task groups and the planning processes that are ongoing. There is every intent to involve as wide a spectrum of the scientific community as possible in order to ensure that the very best ideas are considered for the post-1985 space science objectives of the nation.

This news item was contributed by L. J. Lanzerotti, Ball Laboratories, Murray Hill, N. J.

## APEX: The Arctic Polynya Experiment

A field experiment has been initiated to address the mesoscale oceanographic, sea ice, and meteorological processes associated with a polynya, or high-latitude area of semipermanent open water and vigorous new ice growth. This experiment, called the Arctic Polynya Experiment (APEX), is taking place in and around the St. Lawrence Island Polynya on the northern Bering Sea shelf. This polynya was selected for study because it typifies many such features found throughout the Arctic and Antarctic, relatively accessible, and lies in a region that is of considerable interest due to projected resource development.

A polynya is an open water area which persists despite environmental conditions which

would seem to dictate formation of an ice cover. Such areas may be due to a variety of causes. The majority appear to occur, however, when a physical barrier, such as a coastline or a channel constriction, allows prevailing winds or currents to sweep newly formed ice away while at the same time preventing existing ice from moving into the area. The St. Lawrence Island Polynya occurs along the southern, or lee, coastline of St. Lawrence Island away toward the south. Polynyas are of oceanographic interest because they are sites for vigorous, continuous ice formation and are therefore sources both of new ice and of dense, brine-enriched water. They are of interest meteorologically because the associated strong sea-air heat fluxes modify the atmospheric boundary layer.

Oceanographic goals of the APEX program include estimation of the mesoscale heat, salt, and momentum fluxes associated with a polynya and definition of the dynamics which affect these fluxes. These goals will be addressed through time series current, temperature, and salinity observations obtained from oceanographic moorings. The data analyses will focus upon polynya-associated dynamics within the context of a coastal dynamics problem and will use descriptive analyses and simple analytic models. Goals of the APEX sea ice studies include estimation of ice formation rates and of the effects of the polynya on regional ice properties and dynamics. Field observations of ice motion will be obtained by using satellite-tracked drift buoys, and ice distribution will be observed with satellites. The analyses will integrate the observed ice distribution and motion with oceanographic and meteorological conditions through a numerical model. Meteorological program goals include estimation of mesoscale and boundary layer effects associated with the polynya. Meteorological conditions will be monitored by using remote recording and satellite transponding weather stations. The data will be analyzed in conjunction with computed regional winds to address the above goals.

The oceanographic moorings are presently in place, having been deployed in early October 1984 from the University of Alaska vessel *Alpha Helix*. It is planned that these moorings will be recovered using the same vessel, in May 1985. Meteorological stations and ice drift buoys will be deployed in February 1985 from a NOAA helicopter operating out of Nome, Alaska. The experiment is funded jointly by the National Science Foundation, the Office of Naval Research, and NOAA.

This news item was contributed by Robin D. Muench, Science Applications International Corp., Bellevue, WA 98005, and Carol H. Pease, Pacific Marine Environmental Laboratory, NOAA, Seattle, WA 98115.

## Exclusive Economic Zone

Following President Reagan's declaration of an Exclusive Economic Zone (EEZ) in March 1983, the National Advisory Committee on Oceans and Atmosphere (NACOA) undertook a study to bring sorting out what implications the proclamation would have on existing and future ocean legislation and policy. As a result of this proclamation and the Reagan administration's earlier decision not to sign the Law of the Sea (LOS) Treaty, much discussion has centered around whether or not the United States should attempt to formulate a comprehensive package containing all oceans-related legislation. According to the NACOA report "The Exclusive Economic Zone of the United States: Some Immediate Policy Issues," most experts argue against such a move. NACOA agreed, recommending that a comprehensive oceans package is not needed nor even desirable at this time. Instead, NACOA argues, emphasis should be placed on assuring that existing U.S. ocean policy is "consistent" with the nondepletable provisions of the LOS treaty. NACOA is a Presidential advisory committee that conducts ongoing reviews of national oceanic and atmospheric policy and reports directly to Congress and the President.

Another major NACOA recommendation called for a clearly defined system for dispute settlement, particularly regarding freedom of navigation through other nations' exclusive economic zones. In order to assure navigational freedoms, NACOA recommended that the United States should not implement any policy that goes beyond those provisions of the LOS treaty. Although disputes cannot be totally avoided, NACOA admits, a system of dispute settlements set up and agreed upon beforehand can help the United States reach timely agreements with other nations. This may be particularly important, says NACOA, because existing treaties with coastal nations leave many gaps where disputes could develop.

A final major NACOA recommendation, now being acted upon, is to conduct a de-

tailed "nuts and bolts" study to determine what implications the EEZ proclamation will have on existing U.S. legislation. The Outer Continental Shelf Lands Act of 1953 is a prime example. The Committee on Atmosphere and Oceans (CAO), a separate interagency committee, is in the process of completing this report, which is due sometime in November.

In related news, NACOA has received funding of \$630,000 through the end of fiscal year 1985, which began October 1. For the past several years the Reagan administration has attempted to eliminate NACOA by cutting its funding, but Congress, as was the case this year, has always intervened.—DWR

## NRC Associateships Available

The National Research Council (NRC) has announced that some 2500 new full-time associateships will be awarded in 1985 for research in the sciences and engineering. Most of the positions are open in both U.S. and non-U.S. nationals and to both recent Ph.D. holders and senior investigators. Applications must be postmarked no later than January 15, 1985. The announcement of initial awards is expected in March and April 1985.

The associateships will be awarded on a competitive basis for research in chemistry, engineering, and mathematics and in the earth, environmental, physical, space, and life sciences. More than 20 federal agencies or research institutions located throughout the United States will participate. Most of the awards will be made for 1 or 2 years. Applicants who have held doctorates for at least 5 years may request shorter terms. Stipends beginning at \$25,350 per year for recent Ph.D. holders will be awarded. A stipend supplement of up to \$5,000 may be available to regular awardees who hold recognized Ph.D.'s in disciplines which fill significantly below the current demand of U.S. graduate schools. Last year these disciplines included engineering, computer science, and space-related biomedical science.

Further information, including applications, specific research opportunities, and federal laboratories participating, is available from Associateships Programs, Office of Scientific and Engineering Personnel, Division D-3, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418 (telephone: 802-334-2760).

## Upcoming Hearings in Congress

The following hearing has been tentatively scheduled by the House of Representatives. The date and time should be verified with the committee or subcommittee holding the hearing; all offices on Capitol Hill may be reached by telephoning 302-224-3121. For guidelines on contacting a member of Congress, see *AGU's Guide to Legislative Information and Contacts* (Eos, August 28, 1984, p. 669).

October 10. Field hearing on U.S. ocean policy by the Subcommittee on Fisheries and Wildlife Conservation and the Environment of the House Merchant Marine and Fisheries Committee, Versailles Room, New Orleans Hilton Hotel, 2 Poydras St., New Orleans, La., 9 A.M.—877R.

## NASA Guest Investigators

The National Aeronautics and Space Administration (NASA) is now seeking guest investigators to participate in the International Sun-Earth Explorer (ISEE) and International Cometary Explorer (ICE) programs. The ISEE/ICE project is a joint NASA/European Space Agency (ESA) venture. A budget of approximately \$500,000 to support the ISEE/ICE Guest Investigator Program is expected for fiscal year 1985, and a similar amount is expected for FY 1986.

Although NASA welcomes proposals at any time, proposals must be received by mid-October in order to be considered in the initial selection. Those arriving after mid-November may be held for another selection period. NASA's objective is to extend and augment established ISEE/ICE programs. Participation and use of data may take several forms. Researchers may use data already collected or plan special operations for future data acquisition and interpretation using program instruments that are already operating. In addition, theoretical interpretive studies in support of specific experimental results from ISEE/ICE may be conducted, as well as comparative studies combining data from another source with ISEE/ICE data.

Questions regarding this guest investigator program should be addressed to John T.

Lynch, Code EE, NASA Headquarters, Washington, D.C. 20546 (telephone: 202-453-1870). Queries specifically regarding comet science only should be sent to William Brunk, Code EL, NASA Headquarters, Washington, D.C. 20546 (telephone: 202-453-1596).

## Space Station Proposals

NASA has issued a request for proposals (RFP) for definition and preliminary design of a permanently manned space station. The station is to be operational in low earth orbit early in the 1990s. According to NASA, the station will "support scientific and commercial endeavors in space, stimulate new technologies, and enhance space-based operational capabilities." Proposals are due November 15, 1984.

Intended to be operational for several decades, the space station will include a number of pressurized modules and a power supply of 75 kilowatts, will support a crew of six to eight people, and will have two or more free-flying unmanned platforms.

The RFP includes four "work packages" covering preliminary designs of space station elements. Contracts to be let for each package are scheduled to begin April 1, 1985. The RFP also requires contractors to study the possibility of using automation and robotic technologies.

Final design and development of the station will begin in 1987. Overall system engineering and integration activities will be performed by NASA's Johnson Space Flight Center, Houston, Tex.

## DOES YOUR LIBRARY SUBSCRIBE TO

*tectonics* is an international scientific journal, sharply focused on interdisciplinary tectonic research.

Why should your library subscribe to *tectonics*? Quite simply because it is the best journal in the field.

Published bimonthly as a cooperative effort between the American Geophysical Union and the European Geophysical Society, each issue of *tectonics* contains original contributions in analytical, synthetic, and integrative tectonics.

*tectonics* deserves a place in the library of your institution or organization. This authoritative journal offers:

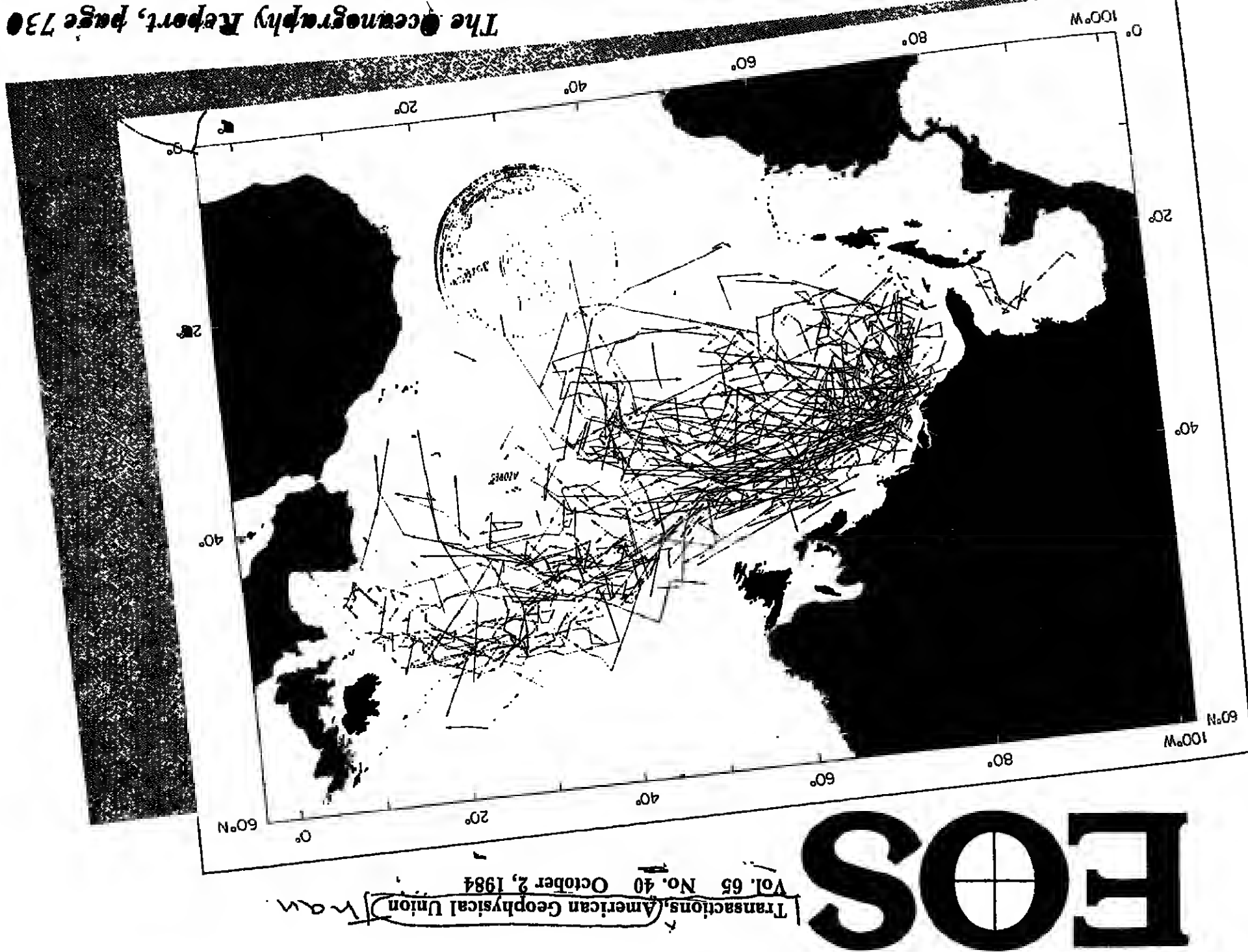
- high-quality original articles
- extensive foldouts of maps and structural diagrams
- stringent refereeing standards, ensuring publication of superior papers
- immediate access to the leading edge of tectonic research
- absolute resources for scientists and students involved in regional geology, structure, tectonics, and hard-rock geology

To begin a subscription or to establish a standing order for this series, have your librarian:

CALL: 800-424-2488  
(202) 462-6903 (local DC area or outside the contiguous USA)

WRITE: American Geophysical Union  
2000 Florida Avenue, NW  
Washington, D.C. 20009

571784



Eos, Transactions, American Geophysical Union

Vol. 65, No. 40, Pages 729-744

October 2, 1984

## Seismology

6970 Structure of the Crust and Upper Mantle (Refomology) OF THE HARBOR SEISMIC REFLECTION PROFILES OF THE PACIFIC ANTECLINORIAL USING A LAND AIR GUN SOURCE  
J. A. Cook (Department of Geology and Geophysics, University of Calgary, Calgary, Alberta T2N 1A3)  
Seismic reflection profiles in the Pacific anticlinorium of southern British Columbia, Canada using a land air gun source has revealed reflections from depths of at least 15-20 km. Interpretations of these data, in conjunction with geological and geophysical information, confirm the allochthonous structure of the Pacific anticlinorium and suggest that autochthonous North American basement is 15-20 kilometers deep beneath the anticlinorium. A westward dip of 15°-20° of the thickness of the crust shows the North American basement surface may be reinterpreted by structural analysis of seismic data, by thrust slices of North American basement rocks, or by both. The geometry observed on the reflection data implies the Pacific anticlinorium is caused by a crustal-scale thrust on the line of the Pacific coast. Further, the data demonstrate that land air gun are effective sources for crustal reflection work. (Seismic methods, Tectonophysics.)

6979 Structure of the Upper Mantle THE DEPTHS OF THE DEEPEST DEEP EARTHQUAKES  
Philip S. Stand and Cliff Frohlich (Institute for Geophysics, The University of Texas at Austin, Austin, Texas, 78712)  
The maximum depth of seismic activity is a fundamental parameter in models of the dynamics of the mantle. Although recent investigations of mantle seismicity and dynamics generally state that seismicity is confined to depths less than 660 km, some studies with focal depths of 720 km have been reported, as have earthquakes with focal depths of 720 km. In several catalogues and studies, the deepest events with reliable focal depths exceeding 600 km occur in several widely separated geographic regions. Events with reported focal depths exceeding 600 km generally possess inconsistent observations, or very few observations. The focal depths of events exceeding 600 km are generally inconsistent with the depths of events exceeding 600 km. The maximum depth of seismic activity is a fundamental parameter in models of the dynamics of the mantle. Although recent investigations of mantle seismicity and dynamics generally state that seismicity is confined to depths less than 660 km, some studies with focal depths of 720 km have been reported, as have earthquakes with focal depths of 720 km. In several catalogues and studies, the deepest events with reliable focal depths exceeding 600 km occur in several widely separated geographic regions. Events with reported focal depths exceeding 600 km generally possess inconsistent observations, or very few observations. The focal depths of events exceeding 600 km are generally inconsistent with the depths of events exceeding 600 km.

J. Geophys. Res., 89, Paper 455049.  
6979 Structure of the Upper Mantle THE DEPTHS OF THE DEEPEST DEEP EARTHQUAKES  
Philip S. Stand and Cliff Frohlich (Institute for Geophysics, The University of Texas at Austin, Austin, Texas, 78712)  
The maximum depth of seismic activity is a fundamental parameter in models of the dynamics of the mantle. Although recent investigations of mantle seismicity and dynamics generally state that seismicity is confined to depths less than 660 km, some studies with focal depths of 720 km have been reported, as have earthquakes with focal depths of 720 km. In several catalogues and studies, the deepest events with reliable focal depths exceeding 600 km occur in several widely separated geographic regions. Events with reported focal depths exceeding 600 km generally possess inconsistent observations, or very few observations. The focal depths of events exceeding 600 km are generally inconsistent with the depths of events exceeding 600 km.

7210 Economic EX-PORT EVALUATION OF FLOOD CONTROL INVESTMENTS: A CASE STUDY IN NORTH DAKOTA  
R. Palaniandi (Department of Agricultural Economics, Texas A&M University, College Station, Texas, 77843) and K. William Warner  
Recent estimates of a flood control project in North Dakota are compared with the Corps of Engineers estimates. Thirty-two percent of the ex-ante benefits were supposed to come from water supply and the rest from flood control. Based on 32 years of data, the ex-ante estimates showed more water supply benefits and flood control benefits 37 times higher than ex-ante estimates. These added flood control benefits resulted from an increased frequency of flooding beginning with the first two years of the project's operation. Finally the ex-ante analysis found that commercial fishing and recreation benefits accounted for 28 percent of the ex-ante benefits. (Flood control, ex-ante project analysis)

Water Resour. Res., 20, Paper 401168.

## Solar Physics, Astrophysics, and Astronomy

7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

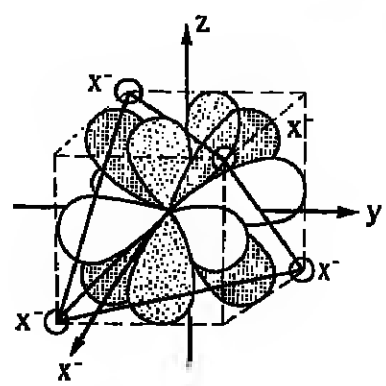
J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 500 \text{ km s}^{-1}$ ) coronal mass ejections (CMEs) with reported metric type II bursts to study the properties of CMEs associated with bursts and to infer the relationship between CMEs and metric type II bursts. We confirm an earlier report of fast front-side CMEs with no associated metric type II bursts and calculate that 23% of all fast front-side CMEs are not associated with metric type II bursts. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks. However, CMEs with fast front-side CMEs are more likely to be associated with type II bursts, as expected from the hypothesis of piston-driven shocks.

J. Geophys. Res., 89, Paper 448130.  
7218 Corona CHARACTERISTICS OF CORONAL MASS EJECTIONS ASSOCIATED WITH SOLAR FRONT-SIDE AND BACK-SIDE METRIC TYPE II BURSTS  
S. K. Kahler (JPL/PSP, Pasadena, CA, 91103), L. W. Cliver, R. A. Sheeley, Jr., S. A. Howard, M. J. Koomen, and J. R. Mullen  
We compare fast ( $v > 5$



# Mineral Physics News



The focal point for the mineral physics community. Editors Robert M. Hazen, Carnegie Institution of Washington, Geophysical Laboratory, 2801 Upton Street, N.W., Washington, DC 20008 (telephone: 202-906-0334).

## What is Mineral Physics?

In the past the principal task of the mineralogist was simply to describe and classify physical, chemical, and structural properties of the remarkable variety of natural inorganic crystals. As this task was gradually accomplished for most species, however, mineralogists increasingly sought to identify physical and chemical principles that underlie mineral formation and behavior and procedures that might lead to predictions of stability and properties of phases deep within the earth. Mineral physics, which has evolved during the past 2 decades, is thus the study of mineralogical problems through the application of the principles of condensed-matter physics and chemistry.

Mineral physics bridges gaps among a number of disciplines. Mineral physics is closely linked with traditional earth-science fields, including solid-earth geophysics, geochemistry, crystallography, petrology, and crystal chemistry. Close ties also exist with topics in ceramics, materials science, physical chemistry, high-temperature and high-pressure research, and solid-state physics. The range of materials studied parallels the diversity of minerals themselves: elements, metal alloys, sulfides, halides, layer compounds, and zeolites. In addition to rock-forming oxides and silicates, have been the focus of much study. Experiments on minerals and their analog compounds have intensified as new industrial applications have been found in the manufacture of lasers, high-performance ceramics, molecular sieves, catalysts, and a wide variety of electronic components.

The methodology of modern mineralogy, both experimental and theoretical, reflects the new objectives of mineral physics. A major focus for many mineral physicists is the precise determination of the physical constants of minerals. Shock-wave and static compression experiments, coupled with measurements of thermal expansion and other properties, are used to calculate equations-of-state for minerals. Ultrasonic and Brillouin-scattering experiments yield the elastic moduli of crystals. Other researchers measure thermal conductivity, electrical conductivity, and magnetic properties of minerals.

In addition to well-known neutron, X-ray and optical microscopic methods of the mineralogist, mineral physicists have adopted a wide range of spectroscopic procedures that reveal aspects of the structure and composition of minerals. Mössbauer, optical, and nuclear magnetic resonance spectroscopy probe the atomic environment and electronic state of ions in crystals. Raman and infrared spectroscopy reveal the molecular and lattice vibrations of mineral crystals. Microprobes that employ beams of electrons, X-rays, and ions have led to ever more precise and spatially resolved compositional determinations.

Our knowledge of mineral structures has

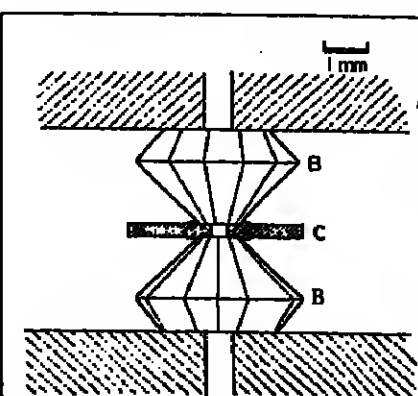


Fig. 1. The diamond anvil pressure cell is an important tool in mineral physics research. Static pressures up to 2.75 Mbars have been attained in studies of mineral properties.

been enhanced by the application of transmission electron microscopy, which has revealed amorphous aspects of crystals including defects and stacking disorder. Quantitative thermodynamic techniques, in particular a variety of calorimetric procedures, provide critical data on the internal energies of minerals. These experimental studies are complemented by computational quantum chemistry, which has led to predictions from first principles in a few simple cases of mineral structure, stability, and physical properties.

Concurrent with the application of these and other new mineralogical techniques has been the remarkable development of high-pressure and high-temperature apparatus for the measurement of mineral structures and properties at geologically-relevant conditions. Progress in diamond-anvil pressure cell technology (Figure 1) and applications of laser heating, in particular, have become major efforts in the mineral physics community.

Underlying much of the mineral physics research is a growing awareness of the dependence of macroscopic properties—particularly those structural and transport properties that influence geophysical behavior—on atomic-level interactions. A major effort, therefore, is underway to document interrelationships among mineral structure, bonding, physical properties, and stability. Such an understanding of minerals will inevitably lead to a more complete understanding of the structure and dynamics of the earth's interior.

## Information Report

### The Mineral Physics Committee

Mineral physics is a diverse field that includes the study of crystal structure, thermochemical properties, physical properties, equations of state, and phase equilibria of minerals and mineral analog compounds. All of these mineral parameters are interrelated, yet they have been traditionally studied and reported by members of different AGU sections. Equations of state and elastic constants are usually included in Tectonophysics, magnetic properties of minerals are often treated in Geomagnetism and Paleomagnetism, and crystal structure and phase equilibria routinely appear in sessions of Volcanology, Geochemistry, and Petrology. Other subjects of interest to the mineral physics community may be reported in Oceanography, Planetary, or Seismology. As a result, many closely related topics have been presented in conflicting sessions at AGU meetings. The extent of this problem was highlighted during the 1983 Spring AGU meeting, when at one point aspects of silicate mineralogy and petrology were discussed concurrently in seven different sessions sponsored by five different sections.

The AGU Executive Council approved the establishment of the AGU Committee on Mineral Physics in March 1983 and charged the Committee to "provide service to the AGU and to the mineral physics scientific community." President Van Allen approved the appointments of Orson Anderson as chairman, and members Peter Bell, Raymond Jeanloz, Robert Lieberman, Muriel Manghnan, Tom Shankland, Tom Ahrens, and Joseph Smith. The latter two members served ex officio as officers in the Tectonophysics and VGP sections, respectively.

The first meeting of the newly established Committee was held at Baltimore, Md., May 31, 1983, and subsequent meetings occurred at San Francisco, Calif., on December 7, 1983, and in Cincinnati, Ohio, on May 15, 1984. One of the Committee's first activities, in addition to coordinating meeting schedules, was to compile a list of mineral physics workers in order to identify the range of interest in mineral properties. This list rapidly expanded to more than 300 scientists in 20 countries, and it soon became evident that, just as mineral physics extends beyond the traditional bounds of any one AGU section, so does it extend well beyond the scope of the earth sciences. Workers in ceramics, solid state chemistry, material science, and theoretical physics are regular contributors of significant results with direct applications to geophysical problems, yet many of these results are not known to AGU members. An expanded role for the Mineral Physics Committee was thus proposed. In addition to the original task of coordinating related AGU meeting sessions and other activities, the Mineral Physics Committee now seeks to foster links among all the diverse elements that comprise the mineral physics community.

Committee activities thus include the organization of symposia, the development of a mineral physics monograph series, the active solicitation of mineral physics articles for AGU periodicals, and the distribution of a newsletter to the international list of researchers in mineral physics. Under the chairmanship of Orson L. Anderson, Professor of Geophysics at the Uni-

versity of California, Los Angeles, several panels have been organized to undertake the activities of the Mineral Physics Committee. The AGU Sessions Program Panel (William Bassett, Charles Previtt, David Kohlstedt, Charles Sammis, and Steven Kirby) is responsible for coordinating mineral physics abstracts in an effort to minimize conflicts between presentations of interest to the mineral physics community. As a first step it is recommended that contributors designate "Mineral Physics Session" on abstracts submitted to AGU meetings. This notation will ensure the inclusion of the paper in an appropriate session.

The Panel on Conferences and Publications (Alexandra Navrotsky, Donald Weidner, Tom Shankland, and Harve Waff) has examined the possibility of a new AGU monograph series on aspects of mineral physics. It is anticipated that the first titles in this series will be announced shortly. The panel is also considering possible topics for Chapman conferences.

The Membership and Publicity Panel (Robert Hazen, Earl Graham, Sue Kieffer, and Leon Thompson) is charged with the task of developing and maintaining a mailing list and with communicating news of interest to the mineral physics community. A growing list, expanded to more than 500 scientists from 30 countries, has been prepared. Requests for sets of pre-printed labels for appropriate mailings will be considered by the panel.

News will be communicated both through periodic "Mineral Physics News" sections of *Eos*, and through mailings to the entire list of mineral physicists, sponsored by a grant from the AGU Council. In this way, AGU will provide the much-needed headquarters for the diverse international mineral physics community.

The Panel on Long-Range Future of Mineral Physics (Orson Anderson, Peter Bell, Muriel Manghnan, and Joseph Smith) has reported on the prospect of augmented federal research funding in mineral physics. A National Research Council (NRC) Panel on the Solid Earth identified "physics and chemistry of earth materials" as one of "five research areas in which significant dividends can be expected as a result of incremental federal investment in FY 1985." Members of the panel will continue to seek opportunities to act in concert with NRC and agency officials to bolster the long-term future of mineral physics.

Other participants in the Mineral Physics Committee include the Nominations Panel (Roger Burns, Daniel Weill, and Hartmut Spetzler), Foreign Secretary (Robert Lieberman), Committee Secretary (J. Michael Brown), and AGU Section Liaisons to Tectonophysics (Tom Ahrens), to VGP (Joseph Smith), and to Geomagnetism and Paleomagnetism (Subir Banerjee). In addition to the original members of the Committee on Mineral Physics, two new members, Roger Burns and Alexandra Navrotsky, have been added.



Orson Anderson, Chairman

## News & Announcements

### Call for Mineral Physics Papers

The editors of *Geophysical Research Letters* (GRL) are attempting to increase submission rates in the fields of solid earth geophysics, and in particular in mineral physics. GRL, which is noted for its record of rapid publication, welcomes short, original articles of new results presented in a way that will make their significance apparent to the general geophysics community. Manuscripts should be sent to James C. G. Walker, Editor, *Geophysical Research Letters*, 2455 Hayward, Ann Arbor, MI 48109.

### Mineral Physics News: Call for Contributions

*Mineral Physics News* will appear biannually in *Eos*. News, notes, reviews, or other material of general interest to AGU and the mineral physics community are welcome. Please send information to the editor of *Mineral Physics News*. The next edition of *Mineral Physics News* will be published in April 1985. The deadline for copy is February 28, 1985.

## Meetings

### Developments in High-Pressure and High-Temperature

The Mineral Physics Committee, Tectonophysics Section, and the VGP Section plan a special session on the Fall 1984 AGU meeting in memory of John C. Jamieson. The session will be devoted to recent advances in the areas in which John worked and will include an invited talk on his contributions to geophysics. Additional invited papers by Muriel Manghnan, William Bassett, Robert McQueen, and Buzz Graham, reviewing high-pressure crystallography, shock-wave work, and general high-pressure techniques, will complement the contributed papers. A special issue of the *Journal of Geophysical Research-Solid Earth* is being planned consisting of papers from this session. For further information contact Phil Halleck, 442 Dieke Building, Pennsylvania State University, University Park, PA 16802 (telephone: 814-863-1878).

### High-Resolution Electron Microscopy

As part of the celebration of the centennial of Arizona State University there will be a symposium on high-resolution transmission and analytical electron microscopy from January 7-11, 1985. The goals are to review and evaluate developments in theory, techniques, and application that have been made to the present; and to evaluate new research directions that will arise from the next generation of instruments and techniques that are now becoming available. For further information contact Centennial Symposium, Center for Solid State Science, Arizona State University, Tempe, AZ 85287.

### Microscopic to Macroscopic

A short course will be held immediately prior to the Spring 1985 AGU meeting on relations among thermodynamics, lattice vibrations, coordination geometries, and bonding in minerals. Many aspects of mineral physics, including spectroscopy, crystal chemistry, thermochemistry, phase transitions, and bonding will be integrated in an effort to demonstrate the close correlations between atomic-scale and macroscopic properties of minerals. The Mineralogical Society of America short course is primarily pedagogic in nature, and it is planned to complement that emphasis with a series of research presentations at an all-day symposium of the same title at the 1985 Spring AGU meeting. For more information contact Susan W. Kieffer, U.S. Geological Survey, 2255 North Central Drive, Flagstaff, AZ 86001.

### Quantum Theory and Experiment Applied to Solids

Planning is now underway on a 5-day symposium to review developments in the description of structure and bonding in perfect crystals. This conference, which is to be held May 1986 at the University of Maryland, College Park, is in some ways a sequel to the successful conference on Structure and Bonding in Crystals, which was held at Casde Hot Springs, Ariz., in 1980. Discussions will include experimental and theoretical aspects of small gas molecules relevant to understanding solids, defect solids and glasses, oxide surfaces, and solution and gel species important in natural waters. For information contact Jack Tossell, Department of Chemistry, University of Maryland, College Park, MD 20742.

### Mineral Physics Symposia

There will be one or more mineral physics symposia at the next International Mineralogical Association (IMA) meeting, July 13-18, 1986. Anyone wishing to organize or participate in an IMA symposium should contact Larry Finger, Geophysical Laboratory, 2801 Upton St., N.W., Washington, DC 20008.

Do you know a colleague who would like to join AGU? Call 800-424-2488 and request membership applications.

# Books

## Proterozoic Geology

L. G. Medaris, Jr., C. W. Byers, D. M. Mickelson, and W. C. Shanks (eds.), *Mem. 161*, Geological Society of America, 315 pp., 1983, \$19.00.

Reviewed by P. K. Sims

This book and its companion, *Early Proterozoic Geology of the Great Lakes Region* (Mem. 160 Geological Society of America, 1984), edited by L. G. Medaris, Jr., are the products of an International Proterozoic symposium held at the University of Wisconsin, Madison, May 18-21, 1981. This volume contains 23 papers that present the current thinking of experts on many aspects of Proterozoic evolution of the earth; it is divided into five broad categories: tectonics, magmatism and metamorphism, mineral resources, evolution of life and the atmosphere, and glaciation.

The Proterozoic is a distinctive interval in the geologic history of the earth, encompassing the transition from Archean conditions to those of the Phanerozoic. By Early Proterozoic time, extensive stable continental plates existed, and deformation, deposition, and intrusion styles were comparable to those of today. Also, the amount of free oxygen in the atmosphere and hydrosphere continuously increased during the Proterozoic and eventually reached levels supportive of metazoan evolution.

The Early Proterozoic is characterized by thick epiclastic sedimentary sequences and oceanic-arc volcano-plutonic complexes, which are variably deformed. What tectonic processes were operative during this interval of time is a matter of controversy. The case for Wilson-cycle signatures analogous to modern plate tectonic regimes is presented by Brian Windley, who points to the well-exposed and well-documented Wopmay orogen in northwest Canada as an excellent example. In contrast, A. Kroner and A. J. Baer argue for ensialic orogens. The uniformitarian view

favors Wilson-cycle orogeny, but it is possible that Proterozoic mobile belts underlain by gneisses developed as a result of tectonic processes unique to the Proterozoic (and Archean)?

Oxidation of the atmosphere during the Proterozoic is recorded in the rocks by changes in the nature and type of sedimentation, mineral deposits, and life forms. The interrelation of Proterozoic life, air, water, and sediments through time is ably reviewed by P. E. Cloud. Proterozoic chemical sediments are depleted in  $^{18}\text{O}$  with respect to Phanerozoic analogues, and E. C. Perry, Jr., and S. N. Ahmed propose that the sediments were precipitated from a Proterozoic ocean depleted in  $^{18}\text{O}$ . Others have proposed that the depletion resulted from a hot Proterozoic ocean. As an example of the change in the types of mineral deposits with an evolving atmosphere, J. J. Langford discusses the differences between the Early Proterozoic gold-uranium placer and the younger Proterozoic, high-grade unconformity-type concentrations. Extensive massive-sulfide deposits, which formed most abundantly in the Early Proterozoic, are described by G. H. Gale; and another important deposit type, sediment-hosted lead-zinc deposits, is reviewed by I. B. Lambert.

In a significant paper, S. R. Taylor and S. M. McLennan show that classic sedimentary rocks record the fundamental change in magma chemistry from relatively sodic Archean rocks to more potassic Proterozoic rocks. They demonstrate that rare-earth-element patterns are remarkably uniform in post-Archean sedimentary rocks and conclude that this reflects reworking of older crust. Another distinctive aspect of Proterozoic magmatism was the generation of anorogenic anorthositic, rapakivi granite, and ignimbrites in the interval 1,800-1,000 Ma. J. L. Anderson summarizes a large body of data on these igneous rocks and argues for an origin by fusion of lower crustal material in continental rift environments. F. J. Siskins also empha-

sizes the importance of rifting in the formation of major Proterozoic ore deposit types. Glaciation was widespread at intervals during much of the Proterozoic, and both the evidence for glaciation (W. B. Harland) and the nature of the record (J. C. Crowell) are reviewed.

Two papers are based on paleomagnetic data. J. D. A. Piper reexamines the case for a Proterozoic supercontinent, and D. J. Dunlop and L. D. Schults present several examples illustrating how paleomagnetism decipher magnetic overprints and use them to date and interpret tectonic events.

Readers who seek an overview of all major aspects of Proterozoic geology are likely to be disappointed. For example, papers are missing on orogenic granitoid and volcanic rocks, and their significance in unraveling Proterozoic tectonic environments. This is a minor shortcoming, however, compared to the great value of the book. The authors and editors have succeeded in conveying the distinctive flavor of the Proterozoic. The book is well produced and nearly free of printing errors. It should be on the book shelf of all those interested in the earth's early geologic history.

P. K. Sims is with the U.S. Geological Survey, Denver, Colo.

## Conservation of Water and Related Land Resources

Peter E. Black, Praeger, New York, xs + 209 pp., 1982, \$28.95.

Reviewed by Lynton K. Caldwell

The author was quite clear about the purpose of this book and clearly achieved his intent. In his preface, the author states, "The purpose of this book is to acquaint the reader with a broad understanding of the topics relevant to the management of the nation's water and related land resources." The book is a product of the author's 20 years of work as a teacher, consultant, researcher, and student of watershed management and hydrology and has served as a text for a course entitled Soil and Water Conservation, which the author has taught at the State University of New York, College of Environmental Science and Forestry at Syracuse, New York. But it was also written with the intent to be of use to informal students of water and land related resources on the national level as well.

The objectives of Black's course at Syracuse and its larger purpose define the scope of the book which, again in the author's words, have been "(1) to acquaint students with principles of soil and water conservation; (2) to stimulate an appreciation for an integrated, comprehensive approach to land management; (3) to illustrate the influence of institutional, economic, and cultural forces on the practice of soil and water conservation; and (4) to provide information, methods, and techniques by which soil and water conservation measures are applied to land, as well as the basis for predicting and evaluating results." The book is written in straightforward non-technical language and provides the reader with a set of references, a table of cases, a list of abbreviations, and an adequate index. It impresses this reviewer as a very well edited piece of work.

The contribution of this book to the literature of soil and water conservation appears to be precisely what its author intended. It is a very suitable book for introducing the reader to the basics of the subject. In seven chapters the author moves from consideration of the historical background of water and land use planning through a discussion of water law, the organizations at various governmental levels that are concerned with water resource policies, through a consideration of aspects of policy planning and pollution control, to a discussion of project evaluation. A sixth chapter, one of the longer, deals with projects and programs and is useful for a quick overview of how water projects come into being, although emphasis is on the technical and procedural aspects of program development and only marginally on their political origins. Finally, in a short final chapter the author comments on the concept of "conservation," analyzing its varied uses since the term was adopted by Theodore Roosevelt. All but this last short chapter are followed by summaries, which are of assistance to readers with no previous background in the subject.

This is not a book to which professionals in the field would turn to find the most recent information on the state of the art of land and water conservation or program evaluation. Nevertheless, it is up-to-date as of the time of its publication. It is a book written essentially for beginners, whether students in college or members of the general public, who would like to have some understanding of what the business of water management and conservation is all about.

Lynton K. Caldwell is with Advanced Studies in Science, Technology, and Public Policy, Indiana University, Bloomington.

## AGU Congressional Science Fellowship

The individual selected will spend a year (September to August) on the staff of a congressional committee or a House or Senate member, advising on a wide range of scientific issues as they pertain to public policy questions.

Prospective applicants should have a broad background in science and be articulate, literate, flexible, and able to work well with people from diverse professional backgrounds. Prior experience in public policy is not necessary, although such experience and/or a demonstrable interest in applying science to the solution of public problems is desirable.

The fellowship carries with it a stipend of up to \$28,000, plus travel allowance.

Interested candidates should submit a letter of intent, a curriculum vitae, and three letters of recommendation to AGU. For further details, write Member Programs Division, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009 or telephone 462-6903 or 800-424-2488 outside the Washington, D.C., area.

Deadline: April 1, 1985

## Satellite Microwave Remote Sensing

Edited by T. D. Allen, Halsted, New York, 526 pp., 1983.

Reviewed by George H. Born

This book is a collection of papers that presents results of the analysis by European scientists of data from the Seasat mission. Seasat, launched in 1978, was the first satellite dedicated to microwave remote sensing of the oceans. The spacecraft carried a suite of four microwave sensors, including a radar altimeter, a synthetic aperture radar, a windfield scatterometer, and a scanning multi-channel microwave radiometer. These microwave sensors were supported by a visible and infrared radiometer.

Seasat operated for just over 100 days before its power system failed. In spite of its brief lifetime, the satellite returned a significant amount of unique data on the world's oceans. As evidenced by this book, the data are still under intense investigation by scientists around the world.

A year prior to the launch of Seasat, a group of European scientists submitted a joint proposal to NASA and NOAA for oceanographic, geodetic, and glaciological studies based on the use of Seasat data. The proposal was accepted, and this group became known as the Seasat Users Group of Europe (SURGE).

Almost 4 years after Seasat's launch, a meeting was held at the Royal Society, London, to present the results of the European research together with invited contributions from Canada and the United States. The results of this meeting are effectively summarized in the thirty papers comprising this book. The text is chiefly devoted to the analysis of Seasat data with a wrap-up paper describing plans for the European Space Agency Remote Sensing Satellite, ERS-1.

The 30 papers, each a chapter of the book, include an overview of the Seasat mission, two general papers on data acquisition and processing, two papers dealing with the scatterometer, 13 papers presenting results from the synthetic aperture radar, 10 papers related to the altimeter, and two papers summarizing scanning microwave radiometer results. Many of the papers deal with a comparison of Seasat measurements of winds and waves to those measured by surface ships and







